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**IEEE 802.16 Broadband Wireless Access Working Group <<http://ieee802.org/16>>**


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**Title                    Request/Response Messages for providing Location Information in 802.16j**


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Rakesh Taori, Mi-Sun Do  
 Samsung Advanced Institute of Technology

Voice: +82-31-280-9635  
 mail to: [rakesh.taori@samsung.com](mailto:rakesh.taori@samsung.com)

Hyunjeong Kang, Sungjin Lee,  
 Hyoung Kyu Lim, Jungje Son  
 Samsung Electronics

mail to: [hyunjeong.kang@samsung.com](mailto:hyunjeong.kang@samsung.com)

Kanchei (Ken) Loa, Yi-Hsueh Tsai, Yung-  
 Ting Lee, Shiann-Tsong Sheu, Hua-Chiang  
 Yin, Chih-Chiang Hsieh, Frank C.D. Tsai,  
 Youn-Tai Lee, Heng-Iang Hsu

Voice: +886-2-2739-9616  
 mail to: [loa@iii.org.tw](mailto:loa@iii.org.tw)

Institute for Information Industry  
 8F., No. 218, Sec. 2, Dunhua S. Rd.,  
 Taipei City, Taiwan.

**Source(s)**

Peter Wang, Adrian Boariu, Shashikant  
 Maheshwari, Yousuf Saifullah, Tony Reid,  
 Haihong Zheng

Voice: +1 214-912-4613  
 mail to: [peter.wang@nokia.com](mailto:peter.wang@nokia.com)

Nokia  
 6000 Connection Drive, Irving, TX

[Wen Tong, Mo-Han Fong](mailto:WenTong@nortel.com)  
[Nortel](mailto:WenTong@nortel.com)  
[3500 Carling Avenue](mailto:WenTong@nortel.com)  
[Ottawa, Ontario K2H 8E9](mailto:WenTong@nortel.com)

[Voice: +1 613 7631315](mailto:WenTong@nortel.com)  
[mailto: WenTong@nortel.com](mailto:WenTong@nortel.com)

[I-Kang Fu, Fang-Ching Ren, Chie-Ming  
 Chou, Tzu-Ming Lin](mailto:IKFu@itri.org.tw)  
[ITRI](mailto:IKFu@itri.org.tw)  
[195, Sec. 4, Chung Hsing Rd.](mailto:IKFu@itri.org.tw)  
[Chutung, Hsinchu, Taiwan 310, R.O.C](mailto:IKFu@itri.org.tw)

[mailto: IKFu@itri.org.tw](mailto:IKFu@itri.org.tw)

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**Re:                    IEEE 802.16j Technical Contribution**


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**Abstract**

This contribution proposes the messages for requesting and providing location information in 802.16j

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Purpose Discussion and Adoption in IEEE 802.16j

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## **Request/Response Messages for providing Location Information in 802.16j**

Rakesh Taori, Mi-Sun Do  
*Samsung Advanced Institute of Technology*

Hyunjeong Kang, Sungjin Lee, Hyoung Kyu Lim, Jungje Son  
*Samsung Electronics*

Kanchei (Ken) Loa, Yi-Hsueh Tsai, Yung-Ting Lee, Shiann-Tsong Sheu, Hua-Chiang Yin, Chih-Chiang Hsieh,  
Frank C.D. Tsai, Youn-Tai Lee, Heng-Iang Hsu  
*Institute for Information Industry*

Peter Wang, Adrian Boariu, Shashikant Maheshwari, Yousuf Saifullah, Tony Reid, Haihong Zheng  
*Nokia*

### **Introduction**

This contribution is the result of an ongoing harmonization effort that brings together elements of the contributions C80216j-07\_138.doc and C80216j-07\_065.doc submitted to the January 2007 meeting.

The 802.16j amendment is aimed at extending the 802.16 specification in order to provide multi-hop relaying capabilities in the network. The usage scenarios developed in the context of 802.16j amendment envisages the use of relay stations that will be fixed, nomadic as well as mobile. Under a variety of situations, it may be quite helpful for the infrastructure stations to know the location of the other infrastructure stations. Two examples are provided below:

- One use of the location information is the transmission of a “relevant” set of neighbors in the MOB\_NBR-ADV messages. The need for the selection of a relevant set of neighbors is foreseen because the length of the MOB\_NBR-ADV message is likely to grow as more and more RSs are added to the network. As argued in contribution c80216j-07\_139.doc titled ‘Reduced Neighbor Information Generation and Customized Delivery’, it is irrelevant for each MS in every RS cell to receive channel access parameters about each and every RS in the MR-network. Location information may be useful for infrastructure stations in selecting the relevant neighbors for any given RS for composing customized neighborhood information as suggested in the 802.16j baseline document 80216j-06\_026r2.
- Another application in 802.16j where location information may be helpful is Interference Management. By using the location information, the MR-BS may be able to perform coarse resource allocation.

The current specification does not cater for a standardized method for requesting or providing location information. In this contribution, simple MAC messages for requesting and providing the location information are proposed.

## Coordination Definition

### WGS84 datum

The Global Positioning System (GPS) is based on the World Geodetic System of 1984 (WGS84) datum. WGS84 is a geocentric system, which provides an excellent mathematical representation in relation to the orbiting satellite constellation. Upon the introduction of satellite navigation, several national geodetic organizations immediately grasped the technology to update their datums with modernized geocentric ellipsoids and to reduce existing distortions.

A reference ellipsoid can be described by a series of parameters that define its shape and which include a semi-major axis ( $a$ ), a semi-minor axis ( $b$ ) and its first eccentricity ( $e$ ) and its second eccentricity ( $e'$ ) as shown in Table 1. Depending on the formulation used, ellipsoid flattening ( $f$ ) may be required. This ellipsoid has its origin coincident with the ECEF (Needs to be defined) origin. The X-axis pierces the Greenwich meridian (where longitude = 0 degrees) and the XY-plane make up the equatorial plane (latitude = 0 degrees). The Altitude is described as the perpendicular distance above the ellipsoid.

Table 1. WGS84 Parameters:

semi-major axis ( $a$ )	6378137
semi-minor axis ( $b$ )	$a(1-f) = 6356752.31424518$
ellipsoid flattening ( $f$ )	1/298.257223563
first eccentricity ( $e$ )	$\sqrt{\frac{a^2 - b^2}{a^2}}$
second eccentricity ( $e'$ )	$\sqrt{\frac{a^2 - b^2}{b^2}}$

### LLA Coordinate System

The most commonly used coordinate system today is the latitude, longitude, and altitude (LLA) system. The origin of the system is at the mass center of the earth. The Prime Meridian and the Equator are the reference planes used to define latitude and longitude. The geodetic latitude (there are many other defined latitudes) of a point is the angle from the equatorial plane to the vertical direction of a line normal to the reference ellipsoid. The geodetic longitude of a point is the angle between a reference plane and a plane passing through the point, both planes being perpendicular to the equatorial plane. The geodetic altitude at a point is the distance from the reference ellipsoid to the point in a direction normal to the ellipsoid.

### Reference

[1] "Giri Baleri, Sr.", Datum Transformations of NAV420 Reference Frames, [http://www.xbow.com/Support/Support\\_pdf\\_files/NAV420AppNote.pdf](http://www.xbow.com/Support/Support_pdf_files/NAV420AppNote.pdf)

## Proposed Text Change

### *Insert new subclause 6.3.2.3.65:*

#### 6.3.2.3.65 Location information requesting and response messages

The location information defined in 6.3.2.3.65.3 is based on the World Geodetic System of 1984 (WGS84) datum.

##### 6.3.2.3.65.1 MR\_LOC-REQ message

The MR\_LOC-REQ message may be transmitted by an MR-BS to an RS to request the location information of the RS. This message can also be transmitted by an RS to the MR-BS to request the location of other RSs. The MR\_LOC-REQ message shall be generated in the format shown in Table X1.

The MR\_LOC-REQ message can be set to any report type as specified in Table X1. When an RS sends the MR\_LOC-REQ message, the report type field shall be set to '0b00' (meaning non-periodic).

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>MR_LOC-REQ_Message_Format() {</u>	<u>=</u>	<u>=</u>
<u>  Type = xx</u>	<u>8 bits</u>	<u>=</u>
<u>  Report Mode</u>	<u>2 bits</u>	<u>0b00: Once</u> <u>0b01: Periodic report</u> <u>0b10~11: reserved</u>
<u>  Neighbor Location Req Flag</u>	<u>1 bit</u>	<u>0b0: Location request of the receiving RS only</u> <u>0b1: Request message contains location request for neighboring access stations</u>
<u>  If(Report Mode = 0b01) {</u>	<u>=</u>	<u>Available when the value of Report Mode is set to 0b01.</u>
<u>    Report period</u>	<u>12 bits</u>	<u>Report period in units of frame, a value between 0 to 4095 corresponding to a range of 1 frame to 4096 frame.</u>
<u>  }</u>	<u>=</u>	<u>=</u>
<u>  If( Neighbor Location Req Flag != 0) {</u>	<u>=</u>	<u>If this message is transmitted by an RS to MR-BS</u>
<u>    N_RS</u>	<u>8 bits</u>	<u>Number of neighboring stations for which the RS wants to know the location information.</u>
<u>    For (j=0;j&lt;N_RS;j++) {</u>	<u>=</u>	<u>=</u>
<u>      RSID</u>	<u>48 bits</u>	<u>The 48 bit MAC address of the neighboring station (BS or RS) whose location is requested.</u>
<u>    }</u>	<u>=</u>	<u>=</u>
<u>  }</u>	<u>=</u>	<u>=</u>
<u>  padding</u>	<u>variable</u>	<u>Padding bits to ensure byte aligned.</u>
<u>}</u>	<u>=</u>	<u>=</u>

Table X1.MR\_LOC-REQ message format

The following parameters shall be included in the MR\_LOC-REQ message:

#### **Report mode**

Action code for an RS's report of location information:

0b0: The RS only sends a single response to the location request message.

0b1: The RS reports the location periodically

#### **Neighbor Location Req Flag**

Flag, when set, indicates that this message contains a request for the location of neighboring access stations.

The flag is set to 0 by the MR-BS when requesting the location of the receiving RS

The flag is set to 1 by the RS when requesting the location of the neighboring stations from the MR-BS.

#### **Report period**

This field represents the period with which an RS shall report the location information, if the Report mode option is set to periodic reporting.

### N\_RS

Number of neighboring stations (BSs as well as RSs) whose location is requested.

### 6.3.2.3.65.2 MR\_LOC-RSP message

The MR\_LOC-RSP message shall be transmitted in response to a MR\_LOC-REQ message. The transmitter sends MR\_LOC-RSP message based on the report mode indicated in the MR\_LOC-REQ message. The transmitter of this message shall generate the MR\_LOC-RSP message in accordance with the format shown in Table X2.

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>MR_LOC-RSP Message Format()</u> {	=	=
<u>Type = xx</u>	8 bits	=
<u>Report Mode</u>	2 bits	0b00: Once 0b01: Periodic report 0b10~11: reserved
<u>Neighbor Location Req Flag</u>	1 bit	0b0: Location request of the receiving RS only 0b1: Request message contains location request for neighboring access stations
<u>If (Neighbor Location Req Flag == 0) {</u>	=	<u>If this message is transmitted by an RS to MR-BS</u>
<u>LLA_IE()</u>	64 bits	<u>Specifies the location of relay station in LLA format defined in section 6.3.2.3.62.3.</u>
<u>} else {</u>	=	<u>If this message is transmitted by an MR-BS to RS</u>
<u>N_RS</u>	8 bits	<u>Number of stations whose location information is included in the current MR_LOC-RSP message.</u>
<u>For (j=0;j&lt;N_RS;j++) {</u>	=	=
<u>RSID</u>	48 bits	<u>The 48 bit MAC address of the neighboring station (BS or RS).</u>
<u>LLA_IE()</u>	64 bits	<u>Specifies the location of neighbor access station in LLA deviation format defined in section 6.3.2.3.62.3.</u>
<u>}</u>	=	=
<u>}</u>	=	=
<u>padding</u>	variable	<u>Padding bits to ensure byte aligned.</u>
<u>}</u>	=	=

Table X2:MR\_LOC-RSP message format.

The following parameters shall be included in the MR\_LOC\_RSP message:

### **Report Mode**

Action code for an RS's report of location information:

The RS only sends a single response to the location request message.

The RS reports the location periodically

### **Neighbor Location Req Flag**

Flag, when set, indicates that this message contains a response for the location of neighboring access stations.

The flag is set to 0 by the RS when responding to the location request from the MR-BS.

The flag is set to 1 by the MR-BS when responding to the location request from the RS about the neighboring stations.

### **N\_RS**

Number of neighboring stations (BSs as well as RSs) whose location the receiver responses.

### 6.3.2.3.65.3 LLA IE() format and sequence charts

Table ttt-a LLA IE()

Syntax	Size	Notes
<u>LLA IE()</u>		
<u>Latitude</u>	<u>24 bits</u>	<u>Specifies the latitude of a position in units of 0.0625 seconds, a value between -5184000 to 5184000 corresponding to a range of -90° to +90°.</u>
<u>Longitude</u>	<u>24 bits</u>	<u>Specifies the longitude of a position in units of 0.125 seconds, a value between -5184000 to 5184000 corresponding to a range of -180° to +180°.</u>
<u>Altitude</u>	<u>16 bits</u>	<u>Specifies the altitude of a position in units of m, a value between -32768 and 32767 corresponding to a range of -32768m to 32767m.</u>
<u>}</u>		

#### **Latitude**

Specifies the latitude of a position in units of 0.0625 seconds, a value between -5184000 to 5184000 corresponding to a range of -90° to +90°.

#### **Longitude**

Specifies the longitude of a position in units of 0.125 seconds, a value between -5184000 to 5184000 corresponding to a range of -180° to +180°.

#### **Altitude**

Specifies the altitude of a position in units of m, a value between -32768 and 32767 corresponding to a range of -32768 to 32767m.

Table xxx: Relay location report (part 1)

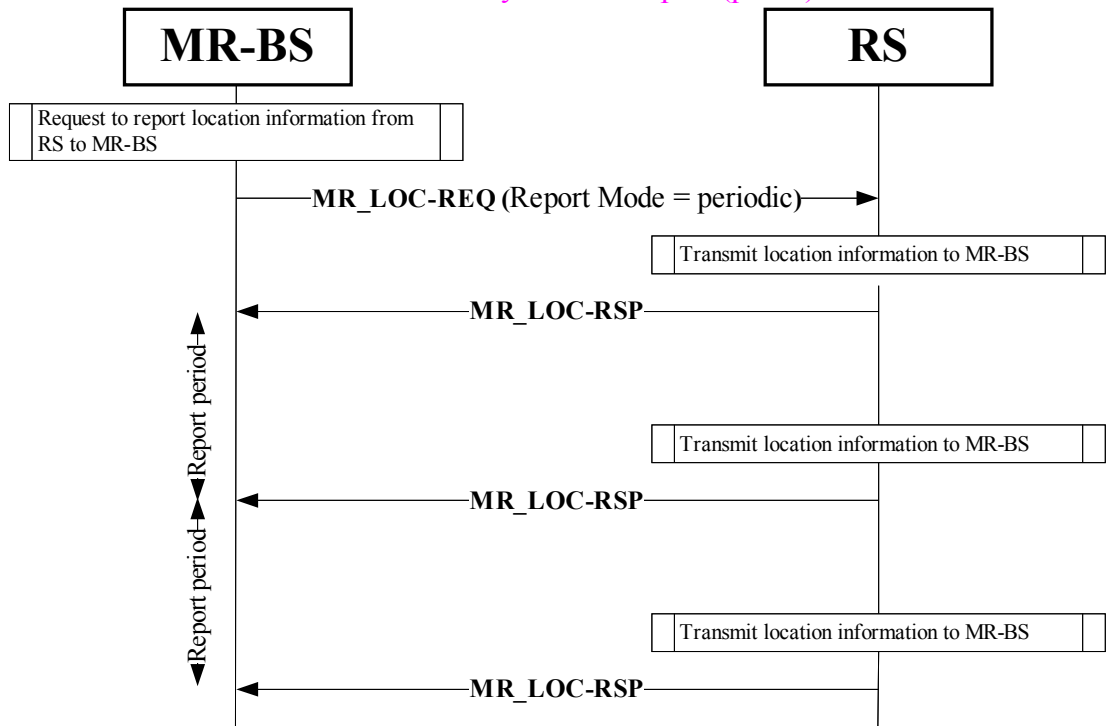


Table xxx: Relay location report (part 2)

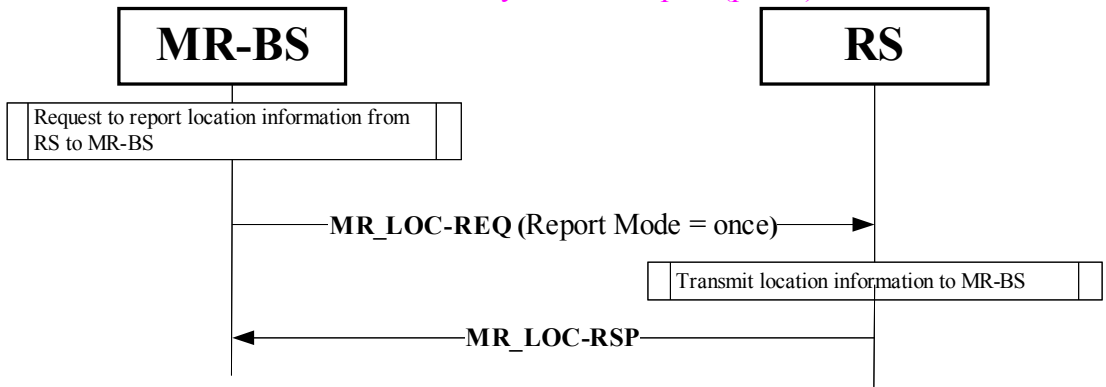
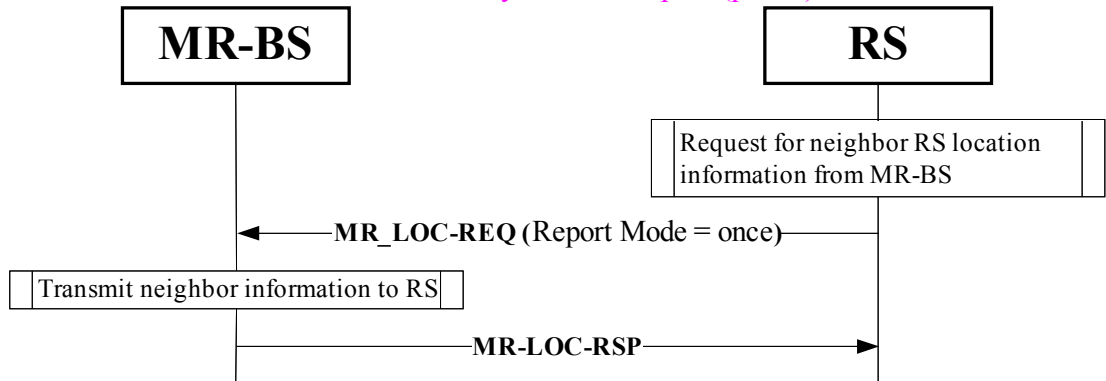


Table xxx: Relay location report (part 3)





*Insert new sub clause 11.7.8.14: 11.7.8 SS capabilities encodings*

#### **11.7.8.14 Location Support**

<b>Name</b>	<b>Type</b>	<b>Length</b>	<b>Value</b>	<b>Scope</b>
<b>Location Support</b>	<b>19</b>	<b>1</b>	<b>0: no location support 1: location support</b>	<b>REG-REQ REG-RSP</b>

**(Note: If there will be “RS capabilities encodings” in 11.7.27 then the Location Support TLV will be inserted in the new subclause 11.7.27.)**